

The SMART-NAS Testbed for Safe Trajectory Based Operations Project will deliver an evaluation capability, critical to the ATM community, allowing full NextGen and beyond-NextGen concepts to be assessed and developed. To meet this objective a strong focus will be placed on concept integration and validation to enable a gate-to-gate trajectory-based system capability that satisfies a full vision for NextGen. The SMART-NAS for Safe TBO Project consists of six sub-projects. Three of the sub-projects are focused on exploring and developing technologies, concepts and models for evolving and transforming air traffic management operations in the ATM+2 time horizon, while the remaining three sub-projects are focused on developing the tools and capabilities needed for testing these advanced concepts. Function Allocation, Networked Air Traffic Management and Trajectory Based Operations are developing concepts and models. SMART-NAS Test-bed, System Assurance Technologies and Real-time Safety Modeling are developing the tools and capabilities to test these concepts.

Simulation and modeling capabilities will include the ability to assess multiple operational scenarios of the national airspace system, accept data feeds, allowing shadowing of actual operations in either real-time, fast-time and/or hybrid modes of operations in distributed environments, and enable integrated examinations of concepts, algorithms, technologies, and NAS architectures. An important focus within this project is to enable the development of a real-time, system-wide safety assurance system. The basis of such a system is a continuum of information acquisition, analysis, and assessment that enables awareness and corrective action to detect and mitigate potential threats to continuous system-wide safety at all levels. This process, which currently can only be done post operations, will be driven towards "real-time" assessments in the 2035 time frame. A description of the six sub-projects follows:

### ***SMART NAS Test-bed***

The goal is to develop a new simulation environment in which

models, airline and ATC operational systems, high-fidelity aircraft simulators, real-time and forecast weather and ATC data are used to provide realistic cost-benefit and impact assessment of proposed technology or procedure, and for real-time decision support.

### ***Function Allocation***

Key to the design of future airspace systems is the question of function allocation for separation assurance. This question is conceptualized along two axes: the allocation of functions i) between human operators and increasingly sophisticated automation systems; and ii) between systems residing on the flight deck and those in ground-based facilities. The goal of the Function Allocation for Separation Assurance Sub-Project is to provide recommendations about the allocation of en route separation assurance functions along these two axes.

### ***Networked Air Traffic Management (ATM)***

Advances in ADS-B, networking technologies, and cloud computing offer a promise of increasing connectivity between people, data, systems and services in ATM dramatically. In particular, these technologies provide broad network access, resource pooling and ability to adopt to changing needs. Several challenges exist in fully utilizing the potential of networking technologies for air traffic management. These include addressing concerns about privacy, security and proprietary data, developing appropriate network architectures and creating innovative concepts using new connections with people, data and systems. Work in this sub-project is divided into two focus areas: (1) net-centric airport systems (2) net-centric airborne systems.

### ***Trajectory Based Operations (TBO)***

The overall goal of the TBO sub-project is to develop TBO concept and technologies to enable a move from a "control volume" paradigm to a "predictive trajectory-based" paradigm in order to reduce delays, increase throughput, improve flight efficiency and/or reduce schedule disruptions while ensuring safety.

### ***System Assurance Technologies***

The goal of this sub-project is the design, development, integration, and deployment of a real-time safety monitoring and assurance system that will be used to make decisions that are critical to the safety of flight operations. This safety monitoring and assurance system will continually evolve as new features and capabilities are added to the NAS, and will necessitate an unprecedented level of integration of new monitoring automation capabilities with existing legacy systems.

### ***Real-time Safety Modeling***

The Real-Time Safety Modeling Sub-Project will investigate methodologies, techniques, and tools to assess and predict safety margins at the local, regional and national airspace levels. It will examine which elements contribute to safety and provide techniques to forecast evolution of individual safety contributors. It is desired to have a mathematical infrastructure to model NAS behavior as it relates to its own safety. This infrastructure will serve as a means to forecast the evolution of the NAS performance through a particular period of traffic flow routing. In addition, given the modeling and forecasting nature of the infrastructure, it will allow for the anticipatory routing optimization using look-ahead NAS safety margin information.